WATER RESOURCES REPORT 28

FLOOD VOLUME DESIGN DATA FOR MISSOURI STREAMS

By John Skelton

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PREPARED IN COOPERATION WITH

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FLOOD-VOLUME DESIGN DATA FOR MISSOURI STREAMS

By John Skelton

ABSTRACT

Results of a statistical analysis of flood-volume information for Missouri are presented in this report. Flood-volume-duration data for selected recurrance intervals are tabulated for 111 continuous-record gaging stations.

By regression analysis, regional flood-volume equations applicable to ungaged sites with drainage basins as small as 0.2 square mile were defined for the Plains and Plateaus regions. Four basin characteristics (drainage area, mean basin elevation, mean runoff, and soils infiltration index) were found to be statistically significant in defining flood volumes; one or more of these variables is required in computing the equations.

INTRODUCTION

During recent years the nationwide construction of flood-control reservoirs and the allocation of capacity in multi-purpose reservoirs for flood control have increased at a higher rate than for any other uses. Growth in numbers and capacity of small flood-storage projects and an increasing use of flood-volume data in design problems appear to be continuing.

Past storage analyses (Skelton, 1968 and 1971) have furnished data that are useful in the design of reservoirs to insure dependable year-round water supplies in Missouri. However, for the planning, design, construction and operation of projects that include the storage of flood waters, flood-volume data are needed. These data can be used to determine the quantity of water to be stored in order to reduce flood damage downstream, for computing waterway capacity for highway drainage structures and for designing spillways for dams.

Discussions with personnel of state and federal agencies and engineering consulting firms during early phases of this project indicated that the information most helpful to them in their work with flood-storage problems would be (1) flood-volume design data at gaged sites and (2) a method of estimating design volumes at ungaged sites, especially for small drainage areas. Consequently, this report is tailored to meet the needs expressed by the primary users of flood-volume data. It contains a tabulation of flood-volume-duration data for selected recurrence intervals at continuous-record stations in the state and presents regional equations for estimating these data at ungaged sites with drainage basins as small as 0.2 square mile.

This report was prepared in the Missouri district of the U.S. Geological Survey, under the direction of Anthony Homyk, District Chief, in cooperation with the Missouri Geological Survey and Water Resources, Wallace B. Howe, State Geologist and Director. The information in this report is based on data collected by the U.S. Geological Survey in cooperation with state and federal agencies.

PHYSIOGRAPHY

Past hydrologic studies in Missouri have shown that physiography has a very pronounced effect on streamflow characteristics. Thus it is important to define the distinctive physiographic regions of the state as a prelude to describing the flood-volume analysis.

The three physiographic divisions of Missouri are the Plains (Osage Plains and Dissected Till Plains), Ozarks (Plateaus) and Southeastern Lowlands (fig. 1).

The Plains is primarily a region of wide valleys with rolling hills. Elevations range from 450 feet above sea level near the Mississippi River to 1,000 feet in the western parts of the area. Much of the region is covered by weathered drift brought in by Ice Age glaciers, causing relatively homogeneous hydrologic conditions throughout the area. As a result, flood-runoff prediction is more accurate for this region than for any other in the state.

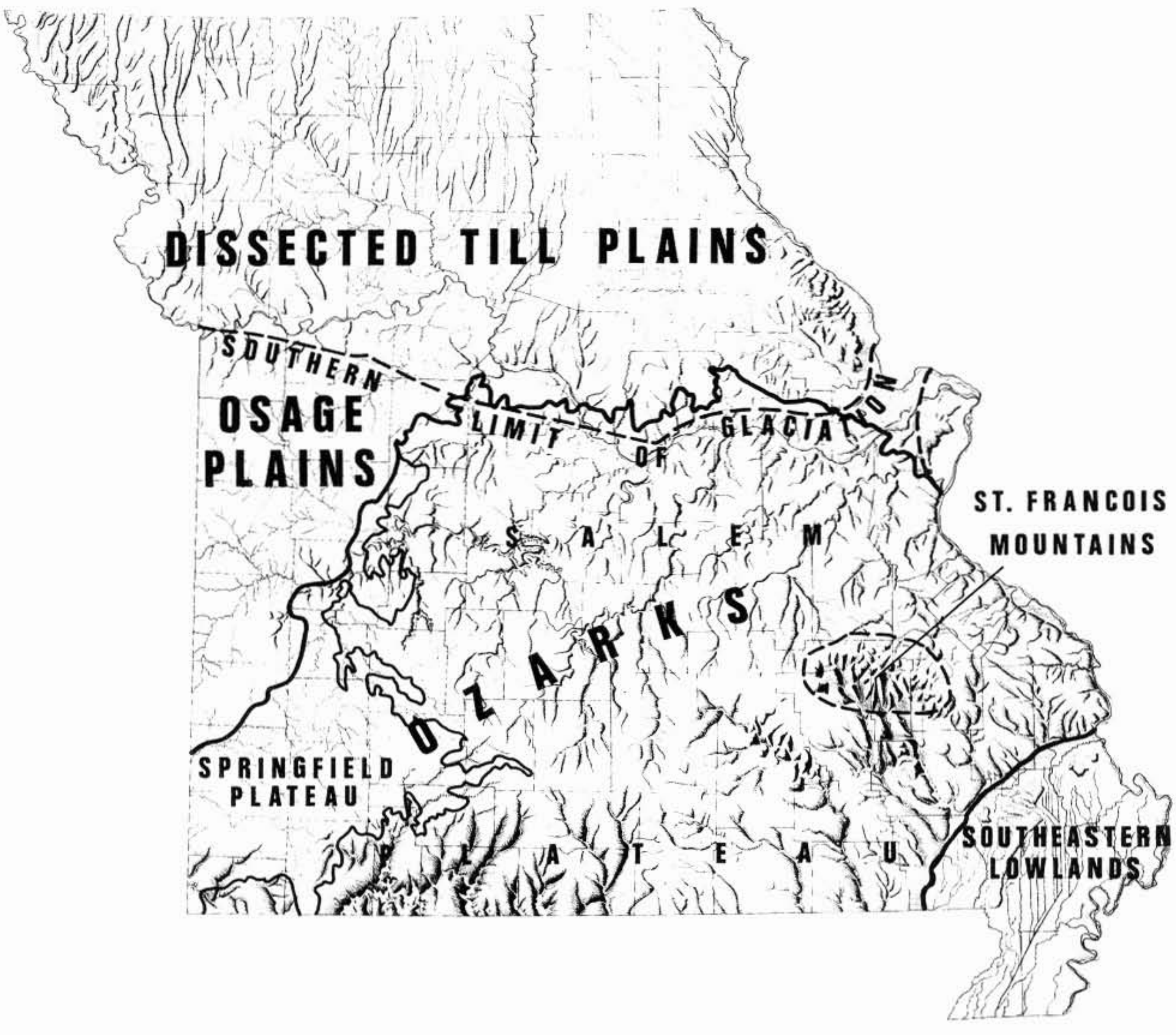

Figure 1

Map of the physiographic divisions of Missouri

The Ozarks region is a fairly rugged area of deep, narrow valleys and sharp ridges in the Salem Plateau area. The Springfield Plateau is generally characterized by rolling hills and wider stream valleys. Elevations in the Ozarks range from about 1,000 feet above sea level to more than 1,600 feet. In some stream basins of the area, intense solutional development in the carbonate rocks, faulting and jointing cause non-homogeneous flood-runoff patterns by diverting major portions of the flood runoff to underground storage. Thus, generalization of streamflow characteristics is difficult, requiring delineation of these anomalous losing areas whenever possible.

The Southeastern Lowlands region, which is located on the Mississippi River alluvial plain, is a relatively flat area of excellent farmland that is drained by numerous man-made channels. Elevations range from 230 to 300 feet above sea level with the exception of Crowley's Ridge where elevations are about 500 feet. Adequate regionalization of hydrologic data in this region is virtually impossible because of difficulty in measuring basin characteristics such as contributing drainage area (it often changes with stream stage) and the uncertainty associated with numerous and frequent man-made changes.

GENERALIZED DESCRIPTION OF FLOOD-RUNOFF PATTERNS

The following brief description of flood-runoff patterns in Missouri is taken from Skelton and Homyk (1970):

"Almost all areas of the State are subject to occasional flooding. Flood runoff per square mile is generally greater in the Ozarks Plateaus than in other areas of the State for drainage areas of comparable size, primarily because of the more rugged topography. However, runoff is quite variable in some sections of the Plateaus during low-order floods because of structural and karst effects. Fault zones and extensive areas of solution openings (sinkholes) in a basin can transmit large quantities of flood runoff from the surface to underground storage reservoirs, causing anomalous patterns of flood runoff. In general, these effects are not evident for floods with recurrence intervals greater than 5 years, although there are some notable exceptions to this rule.

In an average year floods in Missouri are more likely to occur in June, with March and April in second and third place, respectively. Floods are least likely to occur from November through January."

FLOOD-VOLUME-FREQUENCY CHARACTERISTICS AT GAGING STATIONS

The network of gaging stations used to provide data for the flood-volume analysis is shown in plate 1. The stations shown are those that met the following criteria:

a. Ten or more years of available daily-discharge records.

b. More than 25-percent difference in drainage area between gaging stations located on the same stream.

c. Flood data not materially affected by regulation.

d. Adequate definition of the stage-discharge relation.

Annual highest mean discharges in cfs (cubic feet per second) for selected periods were determined from these records by computer. A sample of this output, which is available for 111 Missouri gaging stations, is shown in table 1.

TABLE 1

Annual highest mean discharges, in cubic feet per second, for Thompson Branch near Albany, Mo. (Drainage area = 5.58 square miles)

YEAR	1 Day	3 Days	7 Days	15 Days	30 Days
1956	41.0	21.8	9.3	4.4	2.2
1957	27.0	10.3	4.4	2.1	1.1
1958	290.0	105.0	81.8	44.8	25.9
1959	312.0	114.0	68.5	32.3	16.1
1960	210.0	156.0	78.9	38.3	22.7
1961	400.0	157.0	69.4	51.7	27.0
1962	121.0	83.1	41.7	25.0	16.4
1963	33.0	21.7	10.4	7.0	4.0
1964	220.0	123.0	55.3	26.3	13.3
1965	182.0	132.0	70.0	35.1	18.8
1966	25.0	11.8	6.2	3.0	1.7
1967	125.0	72.3	34.0	25.1	15.6
1968	32.0	13.0	5.6	3.5	1.8
1969	264.0	163.0	71.2	35.3	23.2
1970	197.0	80.3	36.3	23.7	14.5

For the convenience of those using these data, the highest mean discharges are converted to acre-feet for presentation in the appendix. These data represent the annual highest flood volumes for 1-, 3-, 7-, 15- and 30-day periods for selected recurrence intervals at all gaging stations plus 6-, 12- and 18-hour manually-tabulated data for stations with drainage areas less than 50 square miles. The characteristics are noted symbolically in the text and tables. For example, $V_{.25,2}$ represents a 6-hour flood volume with recurrence interval of 2 years; $V_{7,25}$ represents a 7-day flood volume with recurrence interval of 25 years. The 1- to 30-day frequency data for all stations were determined by computer, mathematically fitting a Pearson Type III distribution to the logarithms of the annual flood-volume data, as described by the Water Resources Council (1967). Figure 2 is an example of the log-Pearson Type III curve of annual highest mean discharges for a Missouri gaging station. A graphical frequency curve is used for those stations for which the log-Pearson Type III curve is not a reasonable fit to the data.

Small-area streams in Missouri generally have highly variable flows. Figures of highest mean discharge for durations of less than one day are needed because a large percentage of the total flood volume may occur in short periods on these streams. For the 6-, 12- and 18-hour periods shown in the appendix, a combination of manual tabulation and graphical procedures were used to compute the necessary frequency data. The highest mean discharge for a period of 24 hours is nearly always greater than that of a calendar day during any given year on these streams. Therefore, manually-tabulated 24-hour data were used in the computations instead of 1-day data furnished by the computer for small-area stations, and graphical adjustments to 3-day data were made where necessary for greater accuracy. All small-area frequency computations were based on the adjusted data.

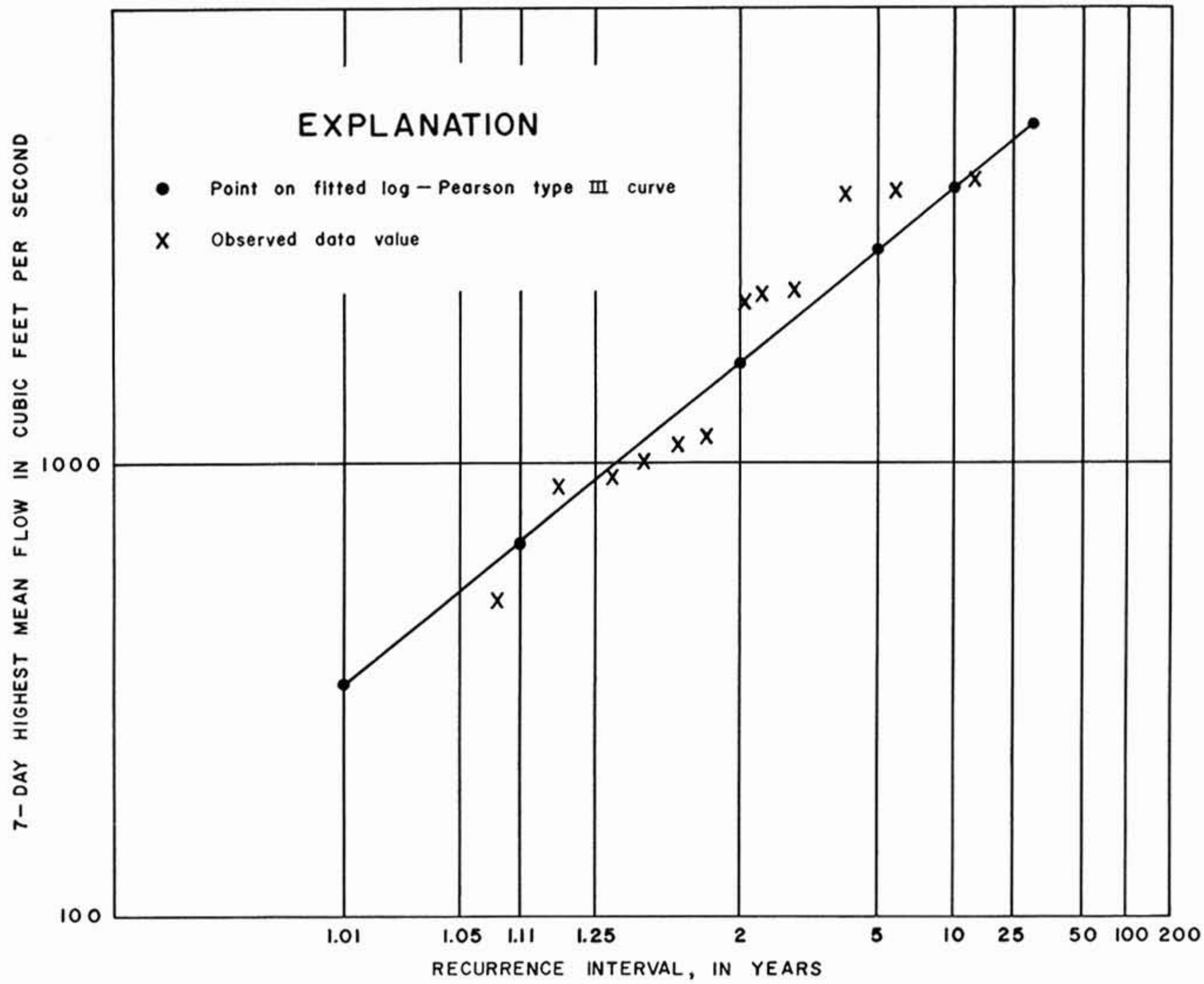

Figure 2

Frequency curve of 7-day highest mean discharges of James River near Springfield, Mo.

TRANSFER OF INFORMATION TO UNGAGED SITES

Each of the flood-volume characteristics defined at gaging stations were related to basin and climatic characteristics by regression; the resulting equations may be used to estimate flood-volume characteristics at ungaged sites.

The regression model used is:

$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 ---- + b_n \log X_n$, *where Y is a statistical flood-volume characteristic such as 1-day flood volume with recurrence interval of 2 years* ($V_{1,2}$)*; the X's are topographic or climatic characteristics; and the other symbols are coefficients obtained by regression.*

Several graphical plots, made early in this study, established the general applicability of this model to the variables used in the analysis.

In the initial phases of this study, the following independent variables were included in the data matrix: drainage area (A), slope (S), length (L), surface storage (St), mean-basin elevation (E), forest cover (F), mean-annual precipitation (P), 2-year, 24-hour precipitation ($I_{24,2}$), mean-annual runoff (R), soils index (Si) and average basin width (W).

A prime assumption in regression analysis is that the various independent variables are not to be highly related to each other. To test this assumption for the flood-volume data matrix, a simple correlation matrix of the 11 evaluated basin characteristics was obtained and analyzed. This procedure indicated that the best results would be obtained by omitting two of

TABLE 2

Summary of regression results – Plains region[1] (Model is $Y = aA^{b_1} E^{b_2} R^{b_3} Si^{b_4}$; Units are Y = acre-feet, A = square miles, E = thousands of feet, R = inches, Si = inches)

Flow characteristic Y	Regression constant a	Exponent of basin characteristics: Drainage area A	Mean basin elevation E	Mean runoff R	Soils Index Si	Standard error of estimate[2] (percent)
$V_{1,2}$	21	0.78	–	0.77	–	26
$V_{1,10}$	57	.73	–	.82	–	29
$V_{1,25}$	74	.70	–	.88	–	34
$V_{1,50}$	42	.69	1.01	1.35	–	36
$V_{1,100}$	39	.68	1.18	1.51	–	39
$V_{3,2}$	65	.88	–	.61	–0.69	20
$V_{3,10}$	55	.86	–	.78	–	25
$V_{3,25}$	68	.84	–	.87	–	28
$V_{3,50}$	72	.83	–	.96	–	32
$V_{3,100}$	74	.82	–	1.05	–	35
$V_{7,2}$	53	.92	–	.70	–.60	18
$V_{7,10}$	45	.92	–	.89	–	19
$V_{7,25}$	50	.90	–	1.01	–	22
$V_{7,50}$	49	.90	–	1.13	–	26
$V_{7,100}$	52	.89	–	1.18	–	29
$V_{15,2}$	48	.95	–	.73	–.45	16
$V_{15,10}$	42	.94	0.52	1.18	–	17
$V_{15,25}$	30	.93	.68	1.35	–	20
$V_{15,50}$	51	.93	–	1.16	–	22
$V_{15,100}$	29	.92	.93	1.59	–	25
$V_{30,2}$	28	.97	–	.88	–	16
$V_{30,10}$	48	.96	–	1.02	–	16
$V_{30,25}$	35	.95	.72	1.38	–	19
$V_{30,50}$	38	.95	.79	1.44	–	21
$V_{30,100}$	37	.95	–	1.23	–	19

[1] Equations are defined by data from streams with drainage areas of 2.5 to 14,000 square miles. Data from 53 gaging stations were used to compute the equations.

[2] Standard error is defined as the standard deviation of the distribution (assumed normal) of residuals about the regression line and is a measure of the reliability of a regression. A standard error of 30 percent, for example, indicates that the flood-volume estimate obtained from the equation will be within ± 30 percent of the correct value at about two-thirds of the ungaged sites.

the variables, length and average basin width, from the data matrix, and this was done for the final regression runs.

The regression equations, standard errors of estimate and the statistical significance of the regression coefficients were obtained by digital computer using the nine basin characteristics chosen for the final analysis. The calculations were then repeated automatically with the least effective basin parameter being omitted in each calculation until only the most effective parameter remained. This procedure was repeated for all the flood volumes selected for this study. The equations selected for use have relatively low standard errors and include only those independent variables that are statistically significant at the 99-percent level.

TABLE 3

Summary of regression results – Plateaus region[1] (Model is $Y = aA^{b_1} E^{b_2} R^{b_3} Si^{b_4}$; Units are Y = acre-feet, A = square miles, E = thousands of feet, R = inches, Si - inches)

Flow characteristic Y	Regression constant a	Exponent of basin characteristics				Standard error of estimate[2] (percent)
		Drainage area A	Mean basin elevation E	Mean runoff R	Soils index Si	
$V_{1,2}$	70	0.86	–	–	–	42
$V_{1,10}$	157	.86	–	–	–	30
$V_{1,25}$	228	.85	–	–	–	33
$V_{1,50}$	296	.84	–	–	–	39
$V_{1,100}$	362	.84	–	–	–	42
$V_{3,2}$	83	.94	–	–	–	38
$V_{3,10}$	535	.96	–	–	–	27
$V_{3,25}$	236	.95	–	–	–	34
$V_{3,50}$	296	.95	–	–	–	40
$V_{3,100}$	361	.95	–	–	–	47
$V_{7,2}$	31	.97	–	.47	–	34
$V_{7,10}$	713	.98	–	–	–1.00	29
$V_{7,25}$	314	.96	–	–	–	39
$V_{7,50}$	395	.95	–	–	–	46
$V_{7,100}$	493	.94	–	–	–	55
$V_{15,2}$	113	1.01	–	–	–	47
$V_{15,10}$	88	.99	–	.43	–	31
$V_{15,25}$	384	.97	–	-	–	44
$V_{15,50}$	483	.97	–	–	–	50
$V_{15,100}$	609	.96	–	–	–	60
$V_{30,2}$	34	1.01	–	.60	–	34
$V_{30,10}$	96	1.01	–	.48	–	31
$V_{30,25}$	450	1.00	–	–	–	43
$V_{30,50}$	565	.99	–	–	–	55
$V_{30,100}$	696	.98	–	–	–	66

[1] Equations are defined by data from streams with drainage areas of 0.2 to 3,800 square miles. Data from 55 gaging stations were used to compute the equations.

[2] Standard error is defined as the standard deviation of the distribution (assumed normal) of residuals about the regression line and is a measure of the reliability of a regression. A standard error of 30 percent, for example, indicates that the flood-volume estimate obtained from the equation will be within ± 30 percent of the correct value at about two-thirds of the ungaged sites.

The independent variables included in the equations of tables 2, 3, and 4 are defined as follows:

a. Drainage area (A), in square miles, was determined from the most recent U.S. Geological Survey topographic maps.

b. Mean basin elevation (E), in feet above mean sea level, was measured on 1:62,500 and 1:24,000 scale U.S. Geological Survey topographic maps for small drainage basins and on 1:250,000 scale U.S. Geological Survey maps for large basins. The elevation was computed by laying a grid over the map, determining the elevation at each grid intersection and averaging those elevations. The grid spacing was selected to give at least 20 intersections within the basin boundary.

c. Mean annual runoff (R), in inches, was computed from the records of stream discharge at each gaging station. The isopleths of annual runoff shown on plate 1 were determined from these station data.

d. Soils infiltration index (Si), in inches, was determined for sub-basins within the state by the Soil Conservation Service (written commun., 1970). These values are shown on plate 1. Weighted averages of these values were used for each gaged drainage basin.

These and other selected drainage basin characteristics have been tabulated for Missouri gaging stations by Skelton and Homyk (1970).

TABLE 4

Summary of regression results – Data for periods of less than 1 day for small drainage areas in the Plains and Plateaus [1] (Model is $Y = aA^{b_1} E^{b_2} R^{b_3} Si^{b_4}$; Units are Y = acre-feet, A = square miles, E = thousands of feet, R = inches, Si = inches)

Flow characteristic Y	Regression constant a	Exponent of basin characteristics: Drainage area A	Mean basin elevation E	Mean runoff R	Soils index Si	Standard error of estimate[2] (percent)
$V_{.25,2}$	64	0.70	−1.20	–	–	52
$V_{.25,10}$	126	.84	–	–	–	41
$V_{.25,25}$	182	.88	–	–	–	42
$V_{.25,50}$	214	.93	–	–	–	45
$V_{.25,100}$	240	.97	–	–	–	51
$V_{.50,2}$	74	.77	−1.19	–	–	51
$V_{.50,10}$	142	.92	–	–	–	40
$V_{.50,25}$	189	.96	–	–	–	40
$V_{.50,50}$	233	1.01	–	–	–	45
$V_{.50,100}$	271	1.03	–	–	–	49
$V_{.75,2}$	75	.79	−1.27	–	–	52
$V_{.75,10}$	168	.90	–	–	–	36
$V_{.75,25}$	198	1.05	–	–	–	47
$V_{.75,50}$	225	1.08	–	–	–	50
$V_{.75,100}$	270	1.10	–	–	–	52

[1] Equations are defined by data from streams with drainage areas of 0.2 to 42 square miles in the Plains and Plateaus. Data from 28 gaging stations were used to compute the equations.

[2] Standard error is defined as the standard deviation of the distribution (assumed normal) of residuals about the regression line and is a measure of the reliability of a regression. A standard error of 30 percent, for example, indicates that the flood-volume estimate obtained from the equation will be within ± 30 percent of the correct value at about two-thirds of the ungaged sites.

DATA ARRANGEMENT

The streamflow data study by Skelton and Homyk (1970) indicated that a grouping of gaging stations by physiographic region and (or) drainage-area size is desirable to optimize results from regression analyses for many streamflow characteristics. Accordingly, regression runs using different groupings of the gaging-station data were made during the flood-volume study in order to compute the most stable regression equations with the lowest practical standard errors of estimate.

The three methods of data arrangement used for regression were as follows:

a. All data were used in the regression to compute a single statewide equation for each flood-volume characteristic.

b. Data were placed into one of two general groups according to physiographic location of gaging stations within the state (Plains or Plateaus).

c. Data were categorized according to drainage area size (less than 50 square miles and greater than 50 square miles).

Flood-volume data for the Southeastern Lowlands region were excluded from the regression runs for several reasons: (1) A network of only 14 continuous-record stations in the alluvial plain of Missouri and Arkansas did not provide sufficient data for a dependable regression analysis; (2) The terrain is so flat that delineation of contributing drainage areas is very difficult; and (3) Extensive and continuing man-made changes in the area are not conducive to effective regionalization of the available information.

The results of regression runs using the three methods of data arrangement plus a combination of methods "b" and "c" indicated that method "b" provided the optimum flood-volume equations for 1- to 30-day data based on stability of the regression coefficients and standard error size. These equations are presented in tables 2 and 3.

FLOOD-VOLUME CHARACTERISTICS FOR SMALL DRAINAGE AREAS

The continuous-record streamflow data available for analysis of flood-volume characteristics for streams with small drainage areas (less than 50 square miles) included 11 gaging stations in the Plains region and 17 in the Ozarks. The stations are well-distributed geographically and are hydrologically representative of small-area flood-volume characteristics in the two regions.

Regression runs were made to determine the feasibility of defining flood-volume equations for each region. However, the resulting regression equations showed considerable instability of the coefficients and uncertainty in the statistical significance of the independent variables.

Next, the data from all 28 Plains and Plateaus small-area stations were used in combination to compute flood-volume equations that would be applicable to both regions. The stability of the coefficients as well as the standard errors of the resulting equations showed substantial improvement over the previous regression runs, and the equations were considered satisfactory for use.

Table 4 is a summary of the regression results for 6-, 12- and 18-hour periods. The equations are applicable to ungaged sites in both the Plains and Plateaus.

ANALYSIS OF RESIDUAL ERRORS

For this report, residual errors are defined as the ratio of flood-volume data measured at each gaging station to that computed from the equations. The amount of deviation from an exact agreement between observed and computed values (1.00) and the geographic distribution or pattern of the values can be used to determine if some significant basin or climatic characteristic has been omitted from the regional analysis. If so, a geographic correction factor can be applied to the appropriate equation.

Analysis of the residuals led to the conclusion that no significant regional patterns exist, although a few large deviations between observed and computed values were noted. Because of this random distribution pattern, no geographic correction factors were deemed necessary.

APPLYING STATION DATA AND REGIONAL EQUATIONS TO DESIGN PROBLEMS

When flood volume information may be used to solve hydrologic problems in the state, this report should be utilized in the following manner:

a. Plate 1 should be examined to determine if any of the gaging station data presented in the appendix are applicable to the problem, with perhaps a small adjustment for drainage area differences. These data should be used whenever possible because they represent hydrologic experience at a particular site rather than a generalization of data from many other stations.

b. At sites where data are not available, the regional equations of tables 2, 3, and 4 must be utilized to obtain flood volume estimates. The equations of tables 2 and 3 are applicable to different physiographic regions; figure 1 must be used to choose the appropriate region. The independent variables necessary for solution of the equations are drainage area (A) in square miles, mean basin elevation (E) in thousands of feet, mean annual runoff (R) in inches, and soils infiltration index (Si) in inches. The variables A and E must be computed by the user from topographic maps. The variables R and Si may be obtained by locating the basin of interest on plate 1 and choosing the appropriate values. Use the center of the basin as the point of estimation for R and interpolate between the isopleths; use an areally weighted average for Si if more than one value is shown upstream from the point of interest.

LIMITATIONS OF REGIONAL EQUATIONS

Prior to project planning and analysis of structural design, the following limitations and restrictions applicable to the regional equations should be considered.

a. The equations are applicable only to sites where flood flow is virtually natural. They do not apply to basins where high flows are affected by regulation, diversion, urbanization or channelization. Because of backwater effects, they are not applicable near the mouths of streams draining into larger streams.

b. The equations should be used only within the range of the drainage-areas shown on tables 2, 3 and 4.

c. The equations are not applicable to the Southeastern Lowlands region.

d. Regionalization results are less precise in the Ozarks than in the Plains region of the state. The cavernous limestone and dolomite formations of the area are capable of altering normal patterns of storm runoff and causing anomalous hydrologic situations within and among basins. The major problem in generalizing flood volumes in the Ozarks is one of economics. Gross overdesign of structures is likely in those basins where significant amounts of storm runoff are diverted to natural underground flood-detention reservoirs and gradually released in the springs and seeps of the region. It can be assumed that only a few basins in the Ozarks are underlain by bedrock so cavernous as to cause a significant reduction in flood volumes during severe floods (recurrence interval of 10 years or more). Logan Creek basin in Reynolds County and the upper Eleven Point River basin in Howell and Oregon Counties are the only ones where sufficient data have been collected to verify this assumption, but a few others may exist. It is recommended that the areas of known deficient runoff patterns indicated on plate 1 be considered when flood-volume estimates are made for the Ozarks. If a structure is to be located in one of these areas, then field reconnaissance during a period of flood runoff will be necessary to make observations of significant deviations from normal flood runoff patterns. If deficient storm runoff is noted, adjustments to design estimates based on engineering judgment will be required to avoid gross overdesign.

SELECTED REFERENCES

Benson, M.A., 1962, Factors influencing the occurrence of floods in a humid region of diverse terrain: U.S. Geol. Survey, Water-Supply Paper 1580-B, 64 p., 1 pl., 9 figs., 4 tbls.

Fenneman, N.M., 1938, Physiography of the eastern United States: McGraw-Hill, 714 p.

Missouri Geological Survey and Water Resources, 1967, Physiography, *in* Mineral and Water Resources of Missouri: Mo. Geol. Survey and Water Resources, 2nd ser., v. 43, p. 14, 1 fig.

Riggs, H.C., 1968, Some statistical tools in hydrology: U.S. Geol. Survey, Techniques of Water Resources Investigations, Book 4, Chap. A 1, 39 p., 26 figs., 5 tbls.

Sandhaus, E.H., and John Skelton, 1968, Magnitude and frequency of Missouri floods: Mo. Geol. Survey and Water Resources, Water Resources Rept. 23, 276 p., 1 pl., 2 figs., 2 tbls., 2 app.

Skelton, John, 1968, Storage requirements to augment low flows of Missouri streams: Mo. Geol. Survey and Water Resources, Water Resources Rept. 22, 78 p., 1 pl., 6 figs., 1 tbl., 1 app.

____________, 1971, Carryover storage requirements for reservoir design in Missouri: Mo. Geol. Survey and Water Resources, Water Resources Rept. 27, 56 p., 1 pl., 9 figs., 1 tbl., 1 app.

Skelton, John, and Anthony Homyk, 1970, A proposed streamflow data program for Missouri: U.S. Geol. Survey, Open-File Rept., 77 p.

U.S. Army Corps of Engineers, 1955, Stream flow volume-duration-frequency studies: Civil Works Investigations Project CW-152, Technical Rept. No. 1.

U.S. Water Resources Council, 1967, A uniform technique for determining flood flow frequencies: U.S. Water Resources Council, Bull. 15, 15 p.

INDEX OF STATION NAMES

Station no. (see app.)	Station name
	A - B
07035500	Barnes Creek near Fredericktown
05502000	Bear Creek at Hannibal
07012000	Behmke Branch near Rolla
07064500	Big Creek near Yukon
06927200	Big Hollow near Fulton
06930000	Big Piney River near Big Piney
07018500	Big River at Byrnesville
07018000	Big River near DeSoto
07061500	Black River near Annapolis
06908000	Blackwater River at Blue Lick
06893500	Blue River near Kansas City
07016500	Bourbeuse River at Union
07015000	Bourbeuse River near St. James
07058000	Bryant Creek near Tecumseh
	C
07043000	Castor River at Aquilla
07021000	Castor River at Zalma
06919500	Cedar Creek near Pleasant View
06904500	Chariton River at Novinger
06905500	Chariton River near Prairie Hill
07037700	Clark Creek near Piedmont
06895000	Crooked River near Richmond
05514500	Cuivre River near Troy
07068000	Current River at Doniphan
07067000	Current River at Van Buren
07066500	Current River near Eminence
	D
07017500	Dry Branch near Bonne Terre
	E
06897000	East Fork Big Creek near Bethany
06894500	East Fork Fishing River at Excelsior Springs
07071500	Eleven Point River near Bardley
07070500	Eleven Point River near Thomasville
05507000	Elk Fork Salt River near Paris
07189000	Elk River near Tiff City
	F
05495000	Fox River at Wayland
07064300	Fudge Hollow near Licking
	G
06933500	Gasconade River at Jerome
06928000	Gasconade River near Hazlegreen
06934000	Gasconade River near Rich Fountain
06928500	Gasconade River near Waynesville
06897500	Grand River near Gallatin
06902000	Grand River near Sumner
07011500	Green Acre Branch near Rolla
	H - I
06902500	Hamilton Branch near New Boston
	J
07066000	Jacks Fork at Eminence
07052500	James River at Galena
07050700	James River near Springfield
06821000	Jenkins Branch at Gower
	K
07070000	Kings Creek near Willow Springs
	L
06907000	Lamine River at Clifton City
07015500	Lanes Fork near Rolla
06928200	Laquey Branch near Hazlegreen
06931500	Little Beaver Creek near Rolla
06894000	Little Blue River near Lake City
06932000	Little Piney Creek at Newburg
07042000	Little River ditch 1 near Kennett
07041000	Little River ditch 81 near Kennett
07044000	Little River ditch 251 near Kennett (includes Little River ditch 66)
07046000	Little River ditch 259 near Kennett
07042500	Little River ditch 251 near Lilbourn
07043500	Little River ditch 1 near Morehouse
06901500	Locust Creek near Linneus
07188500	Lost Creek at Seneca
06935500	Loutre River at Mineola
	M
06927000	Maries River at Westphalia
06900000	Medicine Creek near Galt
07017000	Meramec River at Robertsville

Station no. (see app.)	Station name
	(continued) . . . . .
07019000	Meramec River near Eureka
07013000	Meramec River near Steelville
07014500	Meramec River near Sullivan
05497500	Middle Fabius River near Baring
05498000	Middle Fabius River near Monticello
05506500	Middle Fork Salt River at Paris
06816000	Mill Creek at Oregon
06909500	Moniteau Creek near Fayette
06910500	Moreau River near Jefferson City
	N
06924000	Niangua River near Decaturville
06817500	Nodaway River near Burlington Junction
05497000	North Fabius River at Monticello
05498500	North Fabius River at Taylor
07057500	North Fork River near Tecumseh
05500500	North River at Bethel
05501000	North River at Palmyra
	O
05503000	Oak Dale Branch near Emden
06918700	Oak Grove Branch near Brighton
06819500	102 River near Maryville
06920500	Osage River at Osceola
	P - Q - R
06910000	Petite Saline Creek near Boonville
06820500	Platte River near Agency
06921000	Pomme de Terre River near Bolivar

Station no. (see app.)	Station name
S	
07037500	St. Francis River near Patterson
05508000	Salt River near New London
05502500	Salt River near Shelbina
06908500	Shiloh Branch near Marshall
07187000	Shoal Creek above Joplin
05500000	South Fabius River near Taylor
06907500	South Fork Blackwater River near Elm
05504900	South Fork Salt River near Santa Fe
06922000	South Grand River near Brownington
07185700	Spring River at Larussell
07186000	Spring River near Waco
07185500	Stahl Creek near Miller
06925200	Starks Creek at Preston
	T - U
06813000	Tarkio River at Fairfax
06896500	Thompson Branch near Albany
06899500	Thompson River at Trenton
	V
06926200	Van Cleve Branch near Meta
	W - X
06896000	Wakenda Creek at Carrollton
06899000	Weldon River at Mill Grove
06898500	Weldon River near Mercer
06820000	White Cloud Creek near Maryville
05496000	Wyaconda River above Canton
	Y - Z
05506000	Youngs Creek near Mexico

APPENDIX

Flood-Volume-Duration
Recurrence Data for
Missouri Streamgaging Stations

APPENDIX

Flood-volume-duration recurrence data for Missouri streamgaging stations

Station number	Station name and location	Drainage area (sq mi)	Record used in analysis	Recurrence interval a/ (years)	Flood volume, in acre-feet, for indicated duration, in days							
					0.25	0.50	0.75	1	3	7	15	30
05495000	Fox River at Wayland	400[b]	1924-69	2	-	-	-	10,500	23,200	31,500	42,600	54,000
				10	-	-	-	21,600	46,000	60,200	78,000	99,600
				25	-	-	-	25,800	55,400	71,500	90,600	116,000
				50	-	-	-	36,000	61,200	78,700	108,000	138,000
				100	-	-	-	40,000	78,000	98,000	120,000	156,000
05496000	Wyaconda River above Canton.	393	1933-69	2	-	-	-	9,420	22,600	32,200	42,900	55,200
				10	-	-	-	20,400	46,500	62,000	83,100	109,000
				25	-	-	-	26,800	57,600	73,000	98,400	128,000
				50	-	-	-	32,000	65,400	80,000	129,000	168,000
				100	-	-	-	37,400	72,600	85,700	138,000	198,000
05497000	North Fabius River at Monticello.	452	1924-69	2	-	-	-	13,500	28,200	37,800	46,800	58,200
				10	-	-	-	24,200	52,300	67,300	89,100	113,000
				25	-	-	-	28,000	60,600	76,200	107,000	137,000
				50	-	-	-	30,400	65,400	95,200	135,000	198,000
				100	-	-	-	32,400	78,000	106,000	150,000	240,000
05497500	Middle Fabius River near Baring.	185	1936-60	2	-	-	-	7,600	15,200	18,900	23,700	29,100
				10	-	-	-	14,000	28,000	32,500	41,100	52,500
				25	-	-	-	16,400	26,800	36,800	46,800	60,000
				50	-	-	-	17,700	38,400	44,800	60,000	78,000
05498000	Middle Fabius River near Monticello.	393	1946-69	2	-	-	-	8,640	22,400	32,300	42,300	54,300
				10	-	-	-	16,800	43,300	58,800	73,400	99,000
				25	-	-	-	20,800	52,000	68,300	84,300	116,000
				50	-	-	-	23,800	63,000	84,000	108,000	138,000
05498500	North Fabius River at Taylor.	930	1931-40	2	-	-	-	18,100	46,200	69,700	90,600	106,000
				10	-	-	-	44,600	102,000	148,000	207,000	270,000
				25	-	-	-	58,800	123,000	174,000	300,000	390,000
				50	-	-	-	-	-	-	-	-
				100	-	-	-	-	-	-	-	-
05500000	South Fabius River near Taylor.	620	1937-69	2	-	-	-	13,000	31,900	45,400	59,700	78,600
				10	-	-	-	23,400	57,500	85,100	118,000	152,000
				25	-	-	-	28,400	69,600	105,000	149,000	190,000
				50	-	-	-	32,000	78,000	120,000	172,000	217,000
				100	-	-	-	38,800	85,800	135,000	196,000	244,000
05500500	North River at Bethel.	58[b]	1937-69	2	-	-	-	2,400	4,560	5,500	7,200	9,000
				10	-	-	-	5,500	9,120	10,600	14,400	18,000
				25	-	-	-	7,400	11,500	13,300	18,300	23,400
				50	-	-	-	9,000	13,300	15,400	21,300	27,400
				100	-	-	-	10,700	15,100	17,500	24,300	31,200

05501000	North River at Palmyra.	373	1937-69	2	-	-	-	13,300	24,000	30,200	39,000	53,400
				10	-	-	-	26,000	45,500	58,400	76,800	100,000
				25	-	-	-	32,400	55,100	71,700	94,200	119,000
				50	-	-	-	37,200	61,800	80,900	106,000	138,000
				100	-	-	-	41,600	67,800	89,900	118,000	162,000
05502000	Bear Creek at Hannibal.	31	1940-42, 1948-69	2	850	1,320	1,460	1,650	2,100	2,600	3,000	3,900
				10	1,860	2,650	3,240	3,600	5,140	6,200	6,500	8,100
				25	2,570	3,470	4,230	4,700	6,900	8,050	8,250	10,200
				50	3,060	4,550	5,190	5,900	9,480	10,800	11,000	13,200
				100	-	-	-	-	-	-	-	-
05502500	Salt River near Shelbina.	481	1934-69	2	-	-	-	10,900	26,500	37,900	48,300	63,600
				10	-	-	-	20,800	50,100	70,100	94,500	132,000
				25	-	-	-	25,000	61,200	85,500	119,000	172,000
				50	-	-	-	29,800	69,600	96,500	137,000	240,000
				100	-	-	-	33,400	77,400	107,000	155,000	288,000
05503000	Oak Dale Branch near Emden.	2.64	1956-70	2	170	228	240	260	336	420	480	600
				10	330	455	558	620	690	840	1,020	1,200
				25	480	610	735	840	930	1,100	1,320	1,400
				50	545	730	900	1,030	1,140	1,300	1,560	1,600
05504900	South Fork Salt River near Santa Fe.	295	1940-69	2	-	-	-	10,300	20,400	26,000	31,800	44,100
				10	-	-	-	20,400	44,300	58,400	75,300	101,000
				25	-	-	-	23,800	53,700	72,000	95,400	124,000
				50	-	-	-	29,000	66,000	96,600	135,000	162,000
05506000	Youngs Creek near Mexico.	67.4	1937-67	2	-	-	-	3,300	5,550	6,600	8,100	11,100
				10	-	-	-	6,800	11,400	14,000	17,800	22,500
				25	-	-	-	8,280	13,700	17,500	22,400	27,000
				50	-	-	-	10,000	15,600	22,400	29,100	33,000
				100	-	-	-	11,400	20,400	25,200	33,000	37,200
05506500	Middle Fork Salt River at Paris.	356	1940-69	2	-	-	-	8,440	21,000	30,200	39,600	55,500
				10	-	-	-	19,400	43,400	59,100	79,500	106,000
				25	-	-	-	27,400	57,200	74,700	103,000	132,000
				50	-	-	-	34,600	68,400	86,400	122,000	168,000
05507000	Elk Fork Salt River near Paris.	262	1936-54	2	-	-	-	10,600	21,200	26,500	35,400	44,700
				10	-	-	-	21,200	43,600	53,800	74,100	93,000
				25	-	-	-	25,600	60,000	77,000	93,900	120,000
				50	-	-	-	33,600	70,800	92,400	109,000	142,000
05508000	Salt River near New London	2,480[b]	1923-69	2	-	-	-	49,400	124,000	190,000	253,000	355,000
				10	-	-	-	87,800	232,000	356,000	483,000	690,000
				25	-	-	-	106,000	283,000	433,000	606,000	864,000
				50	-	-	-	119,000	320,000	487,000	702,000	1,000,000
				100	-	-	-	131,000	355,000	540,000	798,000	1,130,000

a/ Recurrence interval is the average interval of time within which a given event will be exceeded once. Recurrence intervals are averages and do not imply regularity of occurrence; an event of 50-year recurrence interval might be exceeded in consecutive years, for instance. In terms of probability, a 50-year flood volume has a 2-percent chance of occurring in any year.

b/ Approximately.

FLOOD-VOLUME-DURATION RECURRENCE DATA (Continued). . . . .

Station number	Station name and location	Drainage area (sq mi)	Record used in analysis	Recurrence interval a/ (years)	Flood volume, in acre-feet, for indicated duration, in days							
					0.25	0.50	0.75	1	3	7	15	30
05514500	Cuivre River near Troy.	903	1924-69	2	-	-	-	34,600	63,000	82,500	109,000	145,000
				10	-	-	-	70,200	133,000	171,000	228,000	317,000
				25	-	-	-	82,600	160,000	204,000	275,000	389,000
				50	-	-	-	116,000	213,000	266,000	345,000	492,000
				100	-	-	-	136,000	246,000	308,000	390,000	576,000
06813000	Tarkio River at Fairfax.	508	1924-69	2	-	-	-	8,620	14,800	20,700	29,400	39,000
				10	-	-	-	19,300	35,600	48,400	66,300	85,200
				25	-	-	-	24,400	46,700	62,600	84,000	106,000
				50	-	-	-	28,000	54,800	72,800	96,000	129,000
				100	-	-	-	31,200	62,400	82,700	107,000	147,000
06816000	Mill Creek at Oregon.	4.90	1951-70	2	126	130	132	140	180	220	270	360
				10	350	395	430	440	468	530	720	840
				25	725	800	900	1,000	1,100	1,200	1,300	1,400
				50	925	950	1,000	1,200	1,800	2,000	2,200	2,440
06817500	Nodaway River near Burlington Junction.	1,240[b]	1924-69	2	-	-	-	18,800	38,400	56,100	79,500	110,000
				10	-	-	-	43,200	92,400	133,000	192,000	262,000
				25	-	-	-	55,800	124,000	176,000	257,000	346,000
				50	-	-	-	65,000	148,000	211,000	309,000	411,000
				100	-	-	-	73,800	173,000	248,000	360,000	476,000
06819500	102 River near Maryville.	500[b]	1933-69	2	-	-	-	11,600	23,400	31,600	43,500	57,600
				10	-	-	-	21,200	47,600	62,300	89,100	115,000
				25	-	-	-	24,400	56,800	72,500	104,000	132,000
				50	-	-	-	30,000	70,800	88,200	138,000	174,000
				100	-	-	-	33,000	80,400	96,600	153,000	195,000
06820000	White Cloud Creek near Maryville.	6.06	1949-69	2	242	300	315	380	456	560	660	840
				10	785	960	1,080	1,100	1,180	1,370	1,620	2,040
				25	1,160	1,310	1,440	1,500	1,550	1,750	2,100	2,640
				50	1,500	1,690	1,830	1,880	1,900	2,000	2,400	3,000
06820500	Platte River near Agency.	1,760[b]	1933-69	2	-	-	-	28,600	74,400	119,000	160,000	206,000
				10	-	-	-	59,000	152,000	248,000	345,000	476,000
				25	-	-	-	82,000	179,000	288,000	408,000	584,000
				50	-	-	-	96,000	234,000	364,000	555,000	720,000
				100	-	-	-	110,000	270,000	420,000	645,000	828,000
06821000	Jenkins Branch at Gower.	2.72	1950-70	2	125	160	188	200	210	280	360	480
				10	520	610	690	720	780	812	900	1,200
				25	800	1,000	1,140	1,200	1,250	1,230	1,380	1,800
				50	1,150	1,380	1,520	1,600	1,700	1,850	1,920	2,160

06893500	Blue River near Kansas City.	188	1941-69	2	-	-	-	10,400	14,900	18,600	24,300	33,900
				10	-	-	-	26,000	40,000	47,600	62,100	79,200
				25	-	-	-	34,200	56,200	64,000	83,100	99,600
				50	-	-	-	44,000	78,000	86,800	112,000	135,000
06894000	Little Blue River near Lake City.	184	1950-69	2	-	-	-	5,860	11,800	14,700	18,900	24,900
				10	-	-	-	13,400	28,400	35,800	47,400	62,400
				25	-	-	-	18,800	35,600	45,500	61,800	90,000
				50	-	-	-	22,000	47,400	61,600	84,000	111,000
06894500	East Fork Fishing River at Excelsior Springs.	20	1953-69	2	715	860	960	1,000	1,140	1,400	1,950	2,400
				10	2,460	3,420	4,050	4,560	5,000	5,530	6,750	8,100
				25	4,680	6,180	7,470	8,160	8,800	9,520	10,100	12,300
				50	6,750	9,950	11,200	12,400	13,000	13,700	14,100	15,900
06895000	Crooked River near Richmond.	159	1950-69	2	-	-	-	5,820	10,200	12,900	16,600	21,000
				10	-	-	-	21,000	36,400	43,400	53,700	67,800
				25	-	-	-	36,000	60,600	69,400	82,200	102,000
				50	-	-	-	52,000	85,800	94,600	108,000	132,000
06896000	Wakenda Creek at Carrollton.	248	1950-69	2	-	-	-	7,600	15,900	20,400	26,100	32,100
				10	-	-	-	12,800	31,600	42,800	54,600	75,600
				25	-	-	-	14,800	40,200	51,200	73,500	108,000
				50	-	-	-	17,000	46,800	61,600	87,000	138,000
06896500	Thompson Branch near Albany.	5.58	1955-70	2	192	250	262	288	390	448	540	600
				10	560	710	825	910	1,190	1,460	1,700	2,040
				25	780	960	1,140	1,300	1,620	2,030	2,400	2,760
				50	935	1,190	1,440	1,630	1,930	2,450	2,800	3,300
06897000	East Fork Big Creek near Bethany.	95	1935-70	2	-	-	-	3,700	7,020	9,400	11,400	13,800
				10	-	-	-	7,200	13,800	16,500	22,500	29,700
				25	-	-	-	8,300	20,400	22,400	26,100	36,000
				50	-	-	-	11,800	25,200	26,600	33,000	52,200
				100	-	-	-	13,600	29,400	30,800	39,000	60,000
06897500	Grand River near Gallatin.	2,250b	1921-69	2	-	-	-	44,000	107,000	154,000	200,000	252,000
				10	-	-	-	91,000	247,000	377,000	498,000	648,000
				25	-	-	-	112,000	315,000	486,000	651,000	876,000
				50	-	-	-	138,000	362,000	563,000	759,000	1,000,000
				100	-	-	-	160,000	405,000	634,000	864,000	1,220,000
06898500	Weldon River near Mercer.	246	1940-59	2	-	-	-	11,400	17,000	21,800	27,900	34,200
				10	-	-	-	31,200	44,600	53,200	63,600	86,400
				25	-	-	-	45,600	63,600	72,500	85,800	121,000
				50	-	-	-	58,400	79,200	88,200	104,000	149,000
06899000	Weldon River at Mill Grove	494	1930-69	2	-	-	-	14,700	27,100	36,700	47,700	60,600
				10	-	-	-	36,800	68,400	84,600	107,000	146,000
				25	-	-	-	51,000	94,200	109,000	137,000	191,000
				50	-	-	-	62,600	115,000	127,000	158,000	240,000
				100	-	-	-	75,200	137,000	144,000	178,000	288,000

a/ Recurrence interval is the average interval of time within which a given event will be exceeded once. Recurrence intervals are averages and do not imply regularity of occurrence; an event of 50-year recurrence interval might be exceeded in consecutive years, for instance. In terms of probability, a 50-year flood volume has a 2-percent chance of occurring in any year.

b/ Approximately.

FLOOD-VOLUME-DURATION RECURRENCE DATA (Continued). . . . .

Station number	Station name and location	Drainage area (sq mi)	Record used in analysis	Recurrence interval a/ (years)	Flood volume, in acre-feet, for indicated duration, in days							
					0.25	0.50	0.75	1	3	7	15	30
06899500	Thompson River at Trenton.	1,670b	1929-69	2	-	-	-	33,400	75,600	114,000	157,000	198,000
				10	-	-	-	81,000	183,000	252,000	345,000	479,000
				25	-	-	-	110,000	244,000	314,000	426,000	636,000
				50	-	-	-	132,000	290,000	392,000	540,000	750,000
				100	-	-	-	156,000	338,000	462,000	615,000	864,000
06900000	Medicine Creek near Galt.	225	1922-69	2	-	-	-	8,100	16,700	21,700	27,300	34,800
				10	-	-	-	17,500	33,400	43,800	57,600	74,400
				25	-	-	-	21,600	39,400	51,500	68,400	88,200
				50	-	-	-	27,000	49,200	64,400	87,000	108,000
				100	-	-	-	32,000	56,400	72,800	102,000	120,000
06901500	Locust Creek near Linneus.	550b	1931-69	2	-	-	-	16,200	35,800	46,200	58,500	79,200
				10	-	-	-	21,800	72,600	99,700	136,000	181,000
				25	-	-	-	36,600	84,000	119,000	167,000	221,000
				50	-	-	-	48,000	108,000	147,000	204,000	276,000
				100	-	-	-	54,000	126,000	168,000	237,000	324,000
06902000	Grand River near Sumner.	6,880b	1925-69	2	-	-	-	103,000	274,000	461,000	624,000	798,000
				10	-	-	-	200,000	545,000	967,000	1,420,000	2,020,000
				25	-	-	-	236,000	648,000	1,160,000	1,760,000	2,680,000
				50	-	-	-	290,000	780,000	1,400,000	1,980,000	3,150,000
				100	-	-	-	330,000	870,000	1,540,000	2,340,000	3,620,000
06902500	Hamilton Branch near New Boston.	2.51	1956-70	2	155	230	248	264	312	420	450	600
				10	312	445	540	620	700	840	1,080	1,320
				25	412	565	705	804	960	1,060	1,500	1,800
				50	450	660	825	970	1,200	1,360	1,920	2,040
06904500	Chariton River at Novinger.	1,370b	1931-52 1955-69	2	-	-	-	17,600	55,900	78,500	124,000	168,000
				10	-	-	-	33,600	101,000	176,000	281,000	386,000
				25	-	-	-	40,400	121,000	225,000	357,000	488,000
				50	-	-	-	48,000	144,000	260,000	408,000	600,000
				100	-	-	-	53,000	159,000	294,000	459,000	660,000
06905500	Chariton River near Prairie Hill.	1,870	1930-69	2	-	-	-	23,600	61,200	110,000	166,000	230,000
				10	-	-	-	37,600	103,000	207,000	354,000	514,000
				25	-	-	-	43,000	119,000	249,000	444,000	654,000
				50	-	-	-	48,000	144,000	308,000	555,000	780,000
				100	-	-	-	54,000	162,000	350,000	630,000	960,000
06907000	Lamine River at Clifton City.	598	1924-69	2	-	-	-	22,800	45,400	58,100	71,000	97,800
				10	-	-	-	50,600	96,600	132,000	178,000	245,000
				25	-	-	-	67,800	125,000	176,000	252,000	344,000
				50	-	-	-	81,800	148,000	211,000	318,000	428,000
				100	-	-	-	96,800	172,000	251,000	390,000	523,000

06907500	South Fork Blackwater River near Elm.	16.6	1955-70	2	610	900	960	1,000	1,300	1,500	1,860	2,400
				10	1,610	2,280	2,790	3,160	3,840	4,200	5,400	6,000
				25	2,160	3,140	3,960	4,580	5,810	6,000	7,350	11,100
				50	2,850	4,320	5,070	5,960	7,620	8,300	9,000	24,600
06908000	Blackwater River at Blue Lick.	1,120[b]	1940-69	2	-	-	-	18,100	48,600	83,700	115,000	143,000
				10	-	-	-	47,000	126,000	221,000	300,000	386,000
				25	-	-	-	68,400	181,000	312,000	414,000	545,000
				50	-	-	-	87,600	230,000	388,000	504,000	678,000
06908500	Shiloh Branch near Marshall.	2.87	1954-65	2	125	160	165	170	192	200	270	300
				10	235	310	368	410	450	500	600	720
				25	365	455	540	600	700	770	900	1,200
06909500	Moniteau Creek near Fayette.	81[b]	1949-67	2	-	-	-	2,940	4,080	5,000	6,750	9,000
				10	-	-	-	4,860	6,900	8,800	10,200	15,600
				25	-	-	-	6,200	8,100	10,600	12,000	19,800
				50	-	-	-	7,000	9,000	12,200	13,200	22,200
06910000	Petite Saline Creek near Boonville.	182	1950-65	2	-	-	-	5,400	10,900	13,100	15,900	21,000
				10	-	-	-	9,900	20,300	27,300	34,500	44,400
				25	-	-	-	11,900	24,800	35,600	45,900	58,200
				50	-	-	-	13,400	28,000	42,100	55,200	69,000
06910500	Moreau River near Jefferson City.	531	1948-69	2	-	-	-	21,400	37,900	46,600	55,200	75,600
				10	-	-	-	33,600	69,600	84,800	117,000	157,000
				25	-	-	-	36,800	90,000	112,000	156,000	194,000
				50	-	-	-	49,000	105,000	129,000	216,000	258,000
06918700	Oak Grove Branch near Brighton.	1.30	1957-70	2	58	72	80	86	110	126	150	180
				10	135	162	180	200	250	308	360	420
				25	172	185	218	250	336	420	540	600
06919500	Cedar Creek near Pleasant View.	420	1950-69	2	-	-	-	13,200	27,500	37,000	48,600	64,800
				10	-	-	-	29,800	61,800	88,200	118,000	145,000
				25	-	-	-	39,000	79,200	116,000	155,000	192,000
				50	-	-	-	52,000	102,000	161,000	216,000	252,000
06920500	Osage River at Osceola.	8,220	1923-69	2	-	-	-	80,000	226,000	461,000	762,000	1,060,000
				10	-	-	-	162,000	468,000	991,000	1,790,000	2,710,000
				25	-	-	-	208,000	600,000	1,270,000	2,360,000	3,710,000
				50	-	-	-	244,000	702,000	1,470,000	2,780,000	4,530,000
				100	-	-	-	282,000	810,000	1,680,000	3,210,000	5,390,000
06921000	Pomme de Terre River near Bolivar.	225	1952-69	2	-	-	-	8,280	13,500	18,800	24,600	33,600
				10	-	-	-	18,400	35,900	50,100	68,700	85,200
				25	-	-	-	24,200	51,600	71,300	99,600	119,000
				50	-	-	-	29,000	65,400	89,200	126,000	148,000

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b/ Approximately.

FLOOD-VOLUME-DURATION RECURRENCE DATA (Continued). . . . .

Station number	Station name and location	Drainage area (sq mi)	Record used in analysis	Recurrence interval a/ (years)	Flood volume, in acre-feet, for indicated duration, in days							
					0.25	0.50	0.75	1	3	7	15	30
06922000	South Grand River near Brownington.	1,660b	1922-69	2	-	-	-	27,000	76,800	141,000	189,000	246,000
				10	-	-	-	65,000	176,000	311,000	429,000	600,000
				25	-	-	-	87,800	246,000	434,000	615,000	762,000
				50	-	-	-	122,000	306,000	518,000	765,000	990,000
				100	-	-	-	148,000	366,000	616,000	900,000	1,170,000
06924000	Niangua River near Decaturville.	627	1931-69	2	-	-	-	18,200	39,200	56,000	78,900	110,000
				10	-	-	-	42,600	90,000	125,000	175,000	234,000
				25	-	-	-	62,000	116,000	162,000	226,000	299,000
				50	-	-	-	77,000	150,000	217,000	263,000	348,000
				100	-	-	-	92,000	177,000	259,000	330,000	395,000
06925200	Starks Creek at Preston.	4.18	1957-70	2	300	350	390	410	480	532	660	720
				10	440	560	660	720	820	980	1,320	1,560
				25	570	650	758	840	1,000	1,180	1,740	2,040
06926200	Van Cleve Branch near Meta.	0.75	1957-70	2	55	66	75	80	82	84	90	120
				10	95	110	130	140	150	168	210	240
				25	120	140	150	170	190	200	270	360
06927000	Maries River at Westphalia.	257	1948-69	2	-	-	-	12,300	19,900	25,800	33,900	46,800
				10	-	-	-	20,200	36,700	51,700	68,100	82,800
				25	-	-	-	23,000	44,300	64,300	96,000	105,000
				50	-	-	-	28,000	56,400	82,600	114,000	120,000
06927200	Big Hollow near Fulton.	4.05	1958-70	2	175	245	262	296	432	560	660	840
				10	295	410	488	550	700	840	1,020	1,440
				25	385	515	600	660	820	1,010	1,260	1,800
06928000	Gasconade River near Hazelgreen.	1,250b	1929-69	2	-	-	-	34,400	72,000	105,000	145,000	199,000
				10	-	-	-	82,000	175,000	239,000	324,000	418,000
				25	-	-	-	106,000	230,000	314,000	420,000	530,000
				50	-	-	-	128,000	306,000	368,000	540,000	690,000
				100	-	-	-	148,000	366,000	424,000	630,000	810,000
06928200	Laquey Branch near Hazelgreen.	1.58	1959-70	2	142	190	200	210	240	255	270	360
				10	258	275	280	290	325	392	480	600
				25	350	360	370	375	420	504	600	720
06928500	Gasconade River near Waynesville.	1,680b	1916-69	2	-	-	-	20,200	96,600	147,000	206,000	289,000
				10	-	-	-	89,800	215,000	314,000	426,000	574,000
				25	-	-	-	115,000	274,000	393,000	534,000	702,000
				50	-	-	-	134,000	348,000	504,000	645,000	840,000
				100	-	-	-	172,000	408,000	588,000	735,000	960,000

06930000	Big Piney River near	560[b]	1922-69	2	-	-	-	18,200	34,000	48,700	68,100	96,600
	Big Piney.			10	-	-	-	34,800	69,600	94,200	130,000	179,000
				25	-	-	-	41,000	85,000	113,000	157,000	218,000
				50	-	-	-	51,000	108,000	125,000	174,000	276,000
				100	-	-	-	56,000	123,000	136,000	204,000	300,000
06931500	Little Beaver Creek	6.41	1948-70	2	325	370	380	400	500	630	840	1,200
	near Rolla.			10	750	840	870	900	1,060	1,400	1,740	2,280
				25	1,100	1,200	1,360	1,400	1,750	1,900	2,300	3,240
				50	1,440	1,750	1,800	1,900	2,000	2,300	2,700	3,900
06932000	Little Piney Creek	200[b]	1930-69	2	-	-	-	5,780	9,840	13,800	18,600	25,800
	at Newburg.			10	-	-	-	16,600	26,700	34,000	43,800	55,500
				25	-	-	-	23,800	37,200	45,900	59,400	72,600
				50	-	-	-	30,000	45,700	55,200	71,700	85,800
				100	-	-	-	36,600	54,800	64,800	85,200	100,000
06933500	Gasconade River at	2,840[b]	1925-69	2	-	-	-	55,200	141,000	223,000	312,000	444,000
	Jerome.			10	-	-	-	121,000	308,000	468,000	651,000	888,000
				25	-	-	-	153,000	388,000	588,000	819,000	1,110,000
				50	-	-	-	175,000	445,000	673,000	942,000	1,270,000
				100	-	-	-	196,000	498,000	755,000	1,060,000	1,430,000
06934000	Gasconade River near	3,180[b]	1923-59	2	-	-	-	55,000	148,000	249,000	363,000	524,000
	Rich Fountain.			10	-	-	-	123,000	317,000	503,000	726,000	1,030,000
				25	-	-	-	157,000	398,000	617,000	894,000	1,270,000
				50	-	-	-	183,000	455,000	770,000	1,060,000	1,620,000
				100	-	-	-	208,000	508,000	910,000	1,200,000	1,830,000
06935500	Loutre River at	202	1949-69	2	-	-	-	7,360	11,200	14,000	18,000	25,800
	Mineola.			10	-	-	-	15,400	22,600	27,000	32,700	45,600
				25	-	-	-	18,700	26,800	35,000	43,500	50,400
				50	-	-	-	20,800	32,400	39,200	51,000	59,400
07011500	Green Acre Branch	0.62	1948-69	2	50	55	60	70	80	90	100	120
	near Rolla.			10	70	80	90	95	100	112	150	180
				25	90	95	100	110	120	154	210	240
				50	130	155	160	170	180	196	270	300
07012000	Behmke Branch	1.05	1949-59	2	70	75	80	85	90	112	150	180
	near Rolla.			10	120	130	138	144	168	238	300	360
				25	160	170	175	180	220	308	420	480
07013000	Meramec River near	781	1923-69	2	-	-	-	23,200	43,900	59,400	78,900	106,000
	Steelville.			10	-	-	-	49,600	95,400	130,000	172,000	213,000
				25	-	-	-	61,800	121,000	169,000	226,000	277,000
				50	-	-	-	70,400	162,000	200,000	270,000	327,000
				100	-	-	-	78,400	192,000	231,000	318,000	380,000

a/ Recurrence interval is the average interval of time within which a given event will be exceeded once. Recurrence intervals are averages and do not imply regularity of occurrence; an event of 50-year recurrence interval might be exceeded in consecutive years, for instance. In terms of probability, a 5-year flood volume has a 2-percent chance of occurring in any year.

b/ Approximately.

FLOOD-VOLUME-DURATION RECURRENCE DATA (Continued). . . . .

Station number	Station name and location	Drainage area (sq mi)	Record used in analysis	Recurrence interval a/ (years)	Flood volume, in acre-feet, for indicated duration, in days							
					0.25	0.50	0.75	1	3	7	15	30
07014500	Meramec River near Sullivan.	1,475	1923-33, 1945-69	2	-	-	-	33,800	75,000	104,000	145,000	204,000
				10	-	-	-	71,400	166,000	225,000	312,000	415,000
				25	-	-	-	88,000	212,000	294,000	408,000	536,000
				50	-	-	-	108,000	245,000	346,000	486,000	630,000
				100	-	-	-	128,000	278,000	400,000	570,000	732,000
07015000	Bourbeuse River near St. James.	21.3	1948-69	2	815	1,140	1,180	1,320	1,740	2,100	2,640	3,600
				10	1,860	2,530	2,970	3,320	3,930	5,040	6,240	7,800
				25	2,820	3,660	4,290	4,560	5,940	7,840	9,360	11,300
				50	3,340	4,550	5,400	5,900	7,500	11,200	14,000	14,600
07015500	Lanes Fork near Rolla.	0.225	1953-65	2	13	15	18	20	24	28	30	60
				10	27	30	36	40	48	56	60	120
				25	38	40	45	48	64	90	110	130
07016500	Bourbeuse River at Union.	808	1922-69	2	-	-	-	22,800	54,500	77,000	101,000	137,000
				10	-	-	-	42,000	104,000	144,000	191,000	274,000
				25	-	-	-	52,400	128,000	178,000	236,000	348,000
				50	-	-	-	60,200	146,000	202,000	270,000	404,000
				100	-	-	-	68,000	164,000	225,000	303,000	460,000
07017000	Meramec River at Robertsville.	2,670	1941-51	2	-	-	-	72,200	184,000	270,000	390,000	540,000
				10	-	-	-	150,000	363,000	512,000	663,000	894,000
				25	-	-	-	190,000	462,000	616,000	855,000	1,170,000
07017500	Dry Branch near Bonne Terre.	3.35	1956-70	2	170	230	240	250	288	350	450	600
				10	260	350	420	470	576	700	840	1,080
				25	345	420	502	580	744	896	1,100	1,320
				50	405	470	555	620	876	1,040	1,300	1,440
07018000	Big River near DeSoto.	718	1949-69	2	-	-	-	23,400	45,200	59,800	81,000	113,000
				10	-	-	-	49,600	95,400	119,000	153,000	211,000
				25	-	-	-	67,800	130,000	157,000	198,000	268,000
				50	-	-	-	84,000	162,000	188,000	237,000	313,000
07018500	Big River at Byrnesville.	917	1924-69	2	-	-	-	25,600	56,600	79,700	112,000	158,000
				10	-	-	-	50,800	114,000	154,000	216,000	302,000
				25	-	-	-	64,400	144,000	193,000	269,000	374,000
				50	-	-	-	74,800	166,000	221,000	309,000	428,000
				100	-	-	-	85,400	188,000	249,000	351,000	481,000
07019000	Meramec River near Eureka.	3,788	1922-69	2	-	-	-	66,600	180,000	287,000	405,000	563,000
				10	-	-	-	137,000	362,000	563,000	780,000	1,090,000
				25	-	-	-	175,000	448,000	696,000	969,000	1,370,000
				50	-	-	-	202,000	508,000	790,000	1,110,000	1,580,000
				100	-	-	-	230,000	563,000	879,000	1,240,000	1,780,000

07021000	Castor River at Zalma.	423	1922-69	2	-	-	-	17,500	38,900	55,200	75,000	105,000
				10	-	-	-	39,600	84,000	112,000	152,000	205,000
				25	-	-	-	51,800	106,000	139,000	190,000	253,000
				50	-	-	-	61,200	123,000	158,000	217,000	288,000
				100	-	-	-	70,800	139,000	176,000	242,000	322,000
07035500	Barnes Creek near Fredericktown.	4.03	1956-70	2	275	300	330	350	510	616	720	960
				10	780	840	900	920	1,000	1,190	1,440	1,680
				25	1,000	1,100	1,150	1,200	1,300	1,510	1,800	2,160
				50	1,200	1,300	1,380	1,440	1,500	1,790	2,160	2,520
07037500	St. Francis River near Patterson.	956	1922-69	2	-	-	-	49,200	91,800	122,000	168,000	232,000
				10	-	-	-	101,000	185,000	235,000	330,000	456,000
				25	-	-	-	126,000	232,000	293,000	417,000	574,000
				50	-	-	-	144,000	266,000	336,000	480,000	660,000
				100	-	-	-	161,000	300,000	379,000	543,000	750,000
07037700	Clark Creek near Piedmont.	4.39	1957-70	2	210	300	330	400	540	672	840	1,080
				10	430	600	720	840	1,080	1,320	1,560	1,920
				25	550	700	885	1,040	1,370	1,680	1,860	2,280
07041000	Little River ditch 81 near Kennett.	111	1927-69	2	-	-	-	3,500	9,200	15,700	22,400	31,700
				10	-	-	-	4,500	16,400	33,600	54,000	75,000
				25	-	-	-	6,300	18,700	41,400	72,300	102,000
				50	-	-	-	6,700	19,900	46,200	86,700	124,000
				100	-	-	-	7,000	20,800	47,600	102,000	148,000
07042000	Little River ditch 1 near Kennett.	235	1927-69	2	-	-	-	8,700	23,100	40,700	57,300	79,200
				10	-	-	-	13,200	39,000	87,400	142,000	200,000
				25	-	-	-	16,000	47,100	106,000	189,000	271,000
				50	-	-	-	17,600	51,000	118,000	222,000	328,000
				100	-	-	-	18,600	55,200	129,000	256,000	385,000
07042500	Little River ditch 251 near Lilbourn.	235	1946-69	2	-	-	-	4,860	13,000	23,100	33,000	49,200
				10	-	-	-	6,620	19,800	44,100	69,000	98,400
				25	-	-	-	7,400	21,900	50,400	87,600	122,000
				50	-	-	-	8,000	23,400	53,900	101,000	139,000
07043000	Castor River at Aquilla.	175	1946-69	2	-	-	-	4,000	11,200	20,700	28,200	38,400
				10	-	-	-	7,320	20,000	38,500	60,000	76,800
				25	-	-	-	9,180	24,700	47,200	77,700	94,800
				50	-	-	-	10,600	28,200	53,600	91,200	108,000
07043500	Little River ditch 1 near Morehouse.	450	1946-69	2	-	-	-	10,700	28,000	48,600	68,400	96,000
				10	-	-	-	15,000	43,500	90,400	146,000	194,000
				25	-	-	-	16,400	47,600	107,000	184,000	239,000
				50	-	-	-	17,600	49,700	112,000	212,000	271,000
07044000	Little River ditch 251 near Kennett (includes Little River ditch 66).	883	1927-69	2	-	-	-	9,760	27,600	54,000	84,000	125,000
				10	-	-	-	14,500	42,100	90,400	155,000	229,000
				25	-	-	-	17,200	46,800	105,000	187,000	276,000
				50	-	-	-	18,400	49,500	114,000	210,000	309,000
				100	-	-	-	19,400	51,800	120,000	231,000	340,000

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FLOOD-VOLUME-DURATION RECURRENCE DATA (Continued). . . . .

Station number	Station name and location	Drainage area (sq mi)	Record used in analysis	Recurrence interval a/ (years)	Flood volume, in acre-feet, for indicated duration, in days							
					0.25	0.50	0.75	1	3	7	15	30
07046000	Little River ditch 259 near Kennett.	89	1927-69	2	-	-	-	3,480	9,240	15,400	20,200	27,000
				10	-	-	-	5,680	16,600	33,500	46,800	59,400
				25	-	-	-	6,800	18,800	41,000	59,700	73,200
				50	-	-	-	7,600	20,000	45,800	68,400	82,200
				100	-	-	-	8,200	20,900	47,600	76,800	90,000
07050700	James River near Springfield.	246	1956-69	2	-	-	-	11,200	18,600	23,700	30,900	40,200
				10	-	-	-	22,600	42,200	57,400	73,800	94,200
				25	-	-	-	29,000	58,800	78,900	102,000	131,000
07052500	James River at Galena.	987	1923-69	2	-	-	-	27,600	56,600	86,500	123,000	175,000
				10	-	-	-	65,400	141,000	206,000	280,000	383,000
				25	-	-	-	87,000	194,000	280,000	381,000	504,000
				50	-	-	-	104,000	239,000	342,000	462,000	600,000
				100	-	-	-	121,000	286,000	409,000	552,000	702,000
07057500	North Fork River near Tecumseh.	561	1945-69	2	-	-	-	13,600	27,600	42,300	62,700	94,800
				10	-	-	-	32,200	58,300	83,600	118,000	173,000
				25	-	-	-	43,000	75,000	105,000	145,000	217,000
				50	-	-	-	51,400	87,600	121,000	165,000	250,000
07058000	Bryant Creek near Tecumseh.	570	1945-69	2	-	-	-	14,900	28,900	42,000	57,300	84,000
				10	-	-	-	33,400	61,200	88,800	120,000	175,000
				25	-	-	-	43,200	78,000	114,000	155,000	224,000
				50	-	-	-	50,600	90,000	133,000	181,000	262,000
07061500	Black River near Annapolis.	484	1940-69	2	-	-	-	20,400	35,500	47,600	67,200	95,400
				10	-	-	-	44,600	73,200	94,900	132,000	180,000
				25	-	-	-	60,600	100,000	128,000	176,000	232,000
				50	-	-	-	74,200	125,000	158,000	215,000	275,000
07064300	Fudge Hollow near Licking.	1.72	1956-67	2	19	22	25	30	36	42	60	65
				10	60	66	72	84	96	112	120	130
				25	128	132	140	142	144	148	150	180
07064500	Big Creek near Yukon.	8.36	1950-70	2	330	500	570	620	840	1,000	1,260	1,800
				10	750	950	1,000	1,060	1,320	1,700	2,400	3,000
				25	1,050	1,200	1,250	1,300	1,700	2,200	2,880	3,600
				50	1,300	1,430	1,510	1,680	1,950	2,600	3,300	3,960
07066000	Jacks Fork at Eminence.	398	1923-69	2	-	-	-	13,300	24,600	34,900	50,400	71,400
				10	-	-	-	31,400	55,000	75,500	109,000	140,000
				25	-	-	-	41,000	70,200	96,600	131,000	175,000
				50	-	-	-	48,200	81,600	112,000	151,000	202,000
				100	-	-	-	55,200	92,400	128,000	171,000	228,000

07066500	Current River near Eminence.	1,272	1923-69	2	-	-	-	32,200	65,400	98,800	145,000	211,000
				10	-	-	-	79,400	144,000	206,000	288,000	404,000
				25	-	-	-	107,000	187,000	260,000	363,000	508,000
				50	-	-	-	129,000	219,000	302,000	420,000	586,000
				100	-	-	-	152,000	251,000	344,000	477,000	666,000
07067000	Current River at Van Buren.	1,667	1923-69	2	-	-	-	37,600	81,000	125,000	184,000	268,000
				10	-	-	-	92,800	181,000	259,000	366,000	521,000
				25	-	-	-	125,000	233,000	330,000	462,000	660,000
				50	-	-	-	150,000	273,000	384,000	534,000	768,000
				100	-	-	-	175,000	313,000	437,000	606,000	882,000
07068000	Current River at Doniphan.	2,038	1923-69	2	-	-	-	42,200	98,400	155,000	235,000	352,000
				10	-	-	-	101,000	219,000	323,000	459,000	660,000
				25	-	-	-	135,000	283,000	413,000	579,000	834,000
				50	-	-	-	162,000	332,000	482,000	669,000	966,000
				100	-	-	-	189,000	380,000	550,000	762,000	1,100,000
07070000	Kings Creek near Willow Springs.	4.91	1955-67	2	90	135	165	184	190	196	240	245
				10	270	325	345	380	432	476	540	660
				25	405	470	510	560	600	700	840	960
07070500	Eleven Point River near Thomasville.	361	1951-69	2	-	-	-	5,700	9,960	12,800	15,000	20,100
				10	-	-	-	13,500	21,400	26,000	31,500	42,000
				25	-	-	-	20,000	31,800	37,800	44,400	56,400
				50	-	-	-	25,000	39,000	44,800	52,500	64,800
07071500	Eleven Point River near Bardley.	793	1922-69	2	-	-	-	12,500	25,600	39,300	61,500	123,000
				10	-	-	-	38,200	70,800	96,300	132,000	265,000
				25	-	-	-	54,800	100,000	131,000	171,000	343,000
				50	-	-	-	68,400	124,000	160,000	201,000	402,000
				100	-	-	-	82,800	148,000	190,000	232,000	464,000
07185500	Stahl Creek near Miller.	3.86	1951-70	2	192	240	255	284	384	490	660	840
				10	395	540	645	740	924	1,160	1,440	1,680
				25	550	710	870	1,010	1,380	1,750	2,040	2,520
				50	640	880	1,100	1,250	1,800	2,240	2,640	3,240
07185700	Spring River at Larussell.	306	1957-69	2	-	-	-	4,060	8,700	14,600	23,100	32,700
				10	-	-	-	13,000	25,600	38,800	53,700	72,600
				25	-	-	-	22,200	40,800	56,000	72,600	97,200
07186000	Spring River near Waco.	1,164	1926-69	2	-	-	-	27,200	61,800	92,400	125,000	168,000
				10	-	-	-	72,800	168,000	256,000	348,000	462,000
				25	-	-	-	102,000	233,000	354,000	480,000	636,000
				50	-	-	-	125,000	285,000	431,000	582,000	768,000
				100	-	-	-	150,000	340,000	511,000	687,000	900,000
07187000	Shoal Creek above Joplin.	410	1942-69	2	-	-	-	10,200	19,800	29,000	40,200	57,000
				10	-	-	-	35,600	70,200	100,000	129,000	171,000
				25	-	-	-	56,000	115,000	162,000	206,000	265,000
				50	-	-	-	75,200	158,000	224,000	281,000	355,000

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FLOOD-VOLUME-DURATION RECURRENCE DATA (Continued). . . . .

Station number	Station name and location	Drainage area (sq mi)	Record used in analysis	Recurrence interval a/ (years)	Flood volume, in acre-feet, for indicated duration, in days							
					0.25	0.50	0.75	1	3	7	15	30
07188500	Lost Creek at Seneca.	42	1949-59	2	320	450	495	570	1,170	1,960	3,000	4,200
				10	2,250	3,180	3,780	4,120	5,400	8,370	11,200	15,900
				25	5,300	6,250	7,500	8,200	10,500	14,100	17,800	24,600
07189000	Elk River near Tiff City.	872	1941-69	2	-	-	-	26,600	54,500	81,100	108,000	149,000
				10	-	-	-	81,800	153,000	216,000	281,000	364,000
				25	-	-	-	123,000	225,000	312,000	411,000	522,000
				50	-	-	-	161,000	289,000	399,000	534,000	666,000

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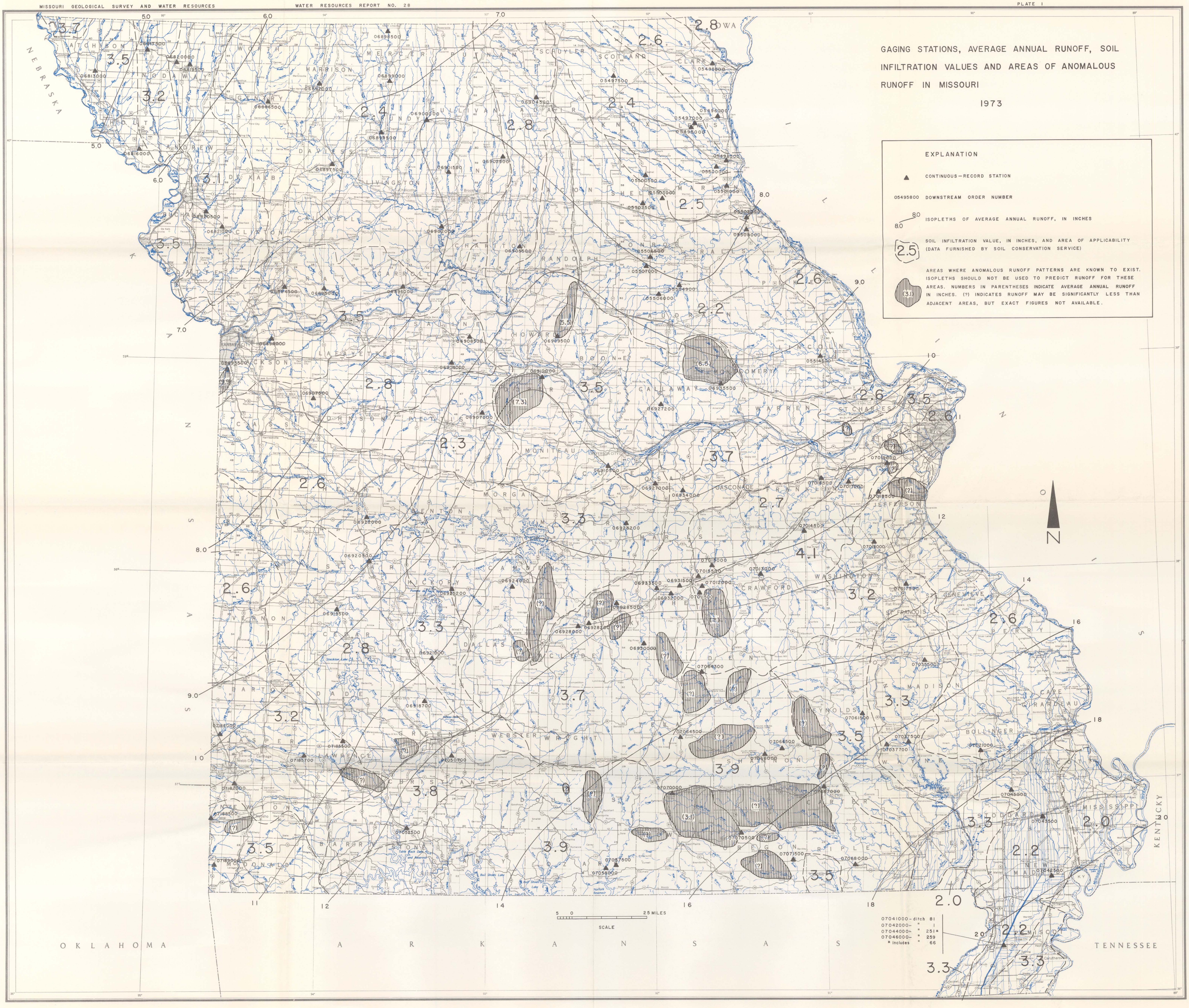
GAGING STATIONS, AVERAGE ANNUAL RUNOFF, SOIL INFILTRATION VALUES AND AREAS OF ANOMALOUS RUNOFF IN MISSOURI
1973
EXPLANATION
CONTINUOUS—RECORD STATION
05495800 DOWNSTREAM ORDER NUMBER
8.0 8.0 ISOPLETHS OF AVERAGE ANNUAL RUNOFF, IN INCHES
2.5 SOIL INFILTRATION VALUE, IN INCHES, AND AREA OF APPLICABILITY (DATA FURNISHED BY SOIL CONSERVATION SERVICE)
(3.1) AREAS WHERE ANOMALOUS RUNOFF PATTERNS ARE KNOWN TO EXIST. ISOPLETHS SHOULD NOT BE USED TO PREDICT RUNOFF FOR THESE AREAS. NUMBERS IN PARENTHESES INDICATE AVERAGE ANNUAL RUNOFF IN INCHES. (?) INDICATES RUNOFF MAY BE SIGNIFICANTLY LESS THAN ADJACENT AREAS, BUT EXACT FIGURES NOT AVAILABLE.
07041000- ditch 81
07042000- " 1
07044000- " 251*
07046000- " 259
* includes " 66
SCALE
25 MILES
NEBRASKA
IOWA
ILLINOIS
KANSAS
KENTUCKY
OKLAHOMA
ARKANSAS
TENNESSEE